10-FT Space Simulator

Facility Description
Building 248

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Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

The Jet Propulsion Laboratory maintains NASA-owned environmental test facilities for research, development and qualification testing of space related test articles. These facilities are available to other government agencies and to private industry.

The 10-Ft Space Simulator (SS) built in 1965 has undergone modifications through the years to satisfy expanding space simulation and cleanliness requirements. Today's facility is capable of producing a vacuum of less than 5×10^{-6} torr, with a pumping system consisting of two cryopumps and a turbomolecular pump. The inside walls of the chamber are lined with temperature controlled shrouds. The area enclosing the lower end bell of the chamber is in a class 10,000 clean room, ensuring test article cleanliness during setup, chamber loading and chamber unloading operations.

The 10-ft Space Simulator has supported many NASA space flight programs as well as spacecraft and satellites for private industry. Typical test usage of the space simulator includes:

- Thermal balance
- Vacuum Bakeouts
- Qualification and functional testing of spacecraft and instruments.

The facility is capable of supporting 24-hour operations over extended periods of time. Past test durations have lasted 24 hours to 31 days.

A. Chamber Details

The chamber is a vertical cylinder measuring 11.3 meters (37 feet) from the lower end bell flange to the upper end bell flange, and 3.96 meters (13 feet) inside diameter. The addition of chamber shrouds reduces the inside diameter to 2.9 meters (9.5 feet). The chamber is a bottom-loading configuration. The bottom of the vessel or "end bell" moves up and down on a 20,000-pound capacity hydraulic lift for installing the test item.

The high vacuum system was upgraded in 1982 from diffusion pumps to the present system of two 90 cm (35-inch) cryopumps and a turbomolecular pump. Cryopumps have improved the cleanliness of the chamber for testing optical instruments and consistently evacuate the chamber into the low 10^{-6} torr range.

The chamber can be evacuated from atmospheric pressure to 1×10^{-5} torr in approximately 2 hours. There are three stages of pumping:

- An Axial Compressor, located in Building 150, which will evacuate the chamber from atmospheric pressure to a pressure of 70 torr in about 90 seconds.
- A mechanical pumping system consisting of two mechanical vacuum pumps and two vacuum booster pumps. The mechanical pumps take the chamber from approximately 70 torr down to 15 torr when the vacuum booster pumps start automatically and take the pressure down to 15 millitorr.
- The last stage consists of two Cryo Pumps and a Turbo Pump, which can take the chamber pressure down to 5×10^{-6} range.

The chamber shrouds are constructed of stainless steel panel-coil with a black painted surface. The shroud temperature can be maintained at -185 degrees C by cooling with liquid nitrogen. Intermediate temperatures from -125 to +125 degrees C can be obtained by either cooling or heating gaseous nitrogen, which is pumped through the shrouds

Ten auxiliary temperature control circuits are available for further tailoring of the test environment to the needs of the customer. Capabilities of this system range from -185°C to +60°C.

Test article support within the chamber can be provided in two ways. On the chamber lower end bell are horizontally mounted concentric support rings. A support fixture can be attached to these rings, which are also temperature controlled. The second mounting method employs cables suspended from a support ring at the top of the chamber.

There is a five-ton bridge crane available for loading the test item on the end bell. The crane and the bottom of the chamber are located in a clean room.

The chamber has a variety of penetrations in the cylinder wall and end bell feed throughs for instrumentation power and temperature control circuits.

B. Power Supplies

Facility power is supplied by Southern California Edison and is available at the following ratings:

- 120 vac, 1 phase
- 208 vac, 3 phase
- 480 vac, 3 phase

In the event of loss of Edison supplied facility power, the facility has two emergency power generators. During loss of facility power, emergency power will support the primary chamber controls, the Data Acquisition System, and the customer's equipment as requested.

C. Customer Ground Support Equipment Area

Within the 10-ft Space Simulator Building (Bldg. 248) a room measuring 18' x 28' is available for the customer to set up test support equipment. Power at the following conditions can be made available:

- 120 vac, 1 phase
- 208 vac, 3 phase
- 480 vac, 3 phase

D. S^3 Data Acquisition System (DAS)

The following list describes the standard instrumentation capabilities of the S^3 Data Acquisition system (DAS) at the 10-ft Space Simulator. Special or additional instrumentation needs can be accommodated as required on an individual basis.

Test Article Instrumentation:

Thermocouples	-	120 channels, type E
RTD	-	40 channels
Heater Control	-	60 power supplies (75 watts each)

Facility Data:

Thermocouples	-	50 channels (shrouds)
Chamber Pressure	-	4 ion gauges
Contamination	-	2 TQCMs

E. Additional Options

An RGA (Residual Gas Analyzer) is available for monitoring gases in the chamber.

F. Clean Room and Test Article Handling Provisions

The first floor area enclosing the lower end bell of the 10-ft Space Simulator is a class 10,000 clean room. Climate control and air filtration is maintained by three HEPA filtered air systems. The Chamber Sweep System, which moves filtered air down through the 10-ft chamber, when the chamber is open, also controls clean room temperature humidity.

Hardware access to the clean room is through a rollup high bay door. Once in the clean room, a 5-ton overhead bridge crane is available for loading/unloading equipment to/from the chamber end bell.

Personnel access in and out of the clean room is through a dressing area and air shower.